

## 5 Cased ammunition

The present invention relates to a method and arrangement intended to impart to fixed service ammunition for barrel weapons, for example charged with so-called LOVA powder, such properties that it is possible to limit to the greatest possible extent the damage to the environment in the event of a hit on or other damage to an ammunition store containing such ammunition which produces a subsequent ammunition fire or other increase in pressure in the ammunition. The arrangement included in the invention is constituted by a cartridge case designed according to the method mentioned above.

LOVA powder is the general designation of a relatively new type of powder which includes fine-particle crystalline explosive substances. LOVA powders are best thought of as insensitive replacements for the conventional nitrocellulose powders. In the development of LOVA powders, efforts have therefore been made to produce powders which under non-pressurized conditions are to have burning properties which are as calm as possible but which during combustion at high pressure are to have at least equally good propellant properties as the nitrocellulose powders which they are intended to replace. The designation LOVA stands for "low vulnerability ammunition" and in Swedish specialist texts the designation "lågkänslig ammunition" {insensitive ammunition} is sometimes seen for this type of product.

The great pressure-sensitivity of LOVA powders as far as their own burning speed is concerned means that there would be much to gain if it were possible rapidly

to reduce the pressure in a LOVA powder which has accidentally been ignited, e.g. by a shell hit on such an ammunition store. By means of such a pressure reduction, it would thus be possible radically to change the course of events from a runaway combustion, which within a very short period of time would lead to the ammunition store exploding, to a relatively calm combustion.

In particular as far as fixed ammunition is concerned, where the powder lies enclosed in sealed cases made of metal, plastic or in certain instances combustible material, it is, however, a matter of considerable difficulty, in the event of an ammunition fire, to bring about a pressure reduction within each charge which is sufficiently rapid to prevent these individually and the ammunition store as a whole exploding. It is also relevant that the problem with an ammunition fire can be assumed to apply to vehicles, e.g. tanks, armoured vehicles, ships, etc. where space is always very restricted. It must moreover be possible for the pressure reduction to take place automatically without any personnel being involved. Moreover, and perhaps most important of all, any measure taken must not in the least endanger the functioning of the ammunition in its regular use.

According to the present invention, the abovementioned problems have now been solved by the cartridge cases in question being provided with longitudinal, accurately adapted weakenings which are designed in such a manner that they do not jeopardize the functioning of the ammunition on firing with the weapon in question by the case then being supported from the outside by the cartridge chamber of the weapon, but which, in the event of an ammunition fire when the ammunition is outside the cartridge chamber of the weapon, as a result of the pressure increase within the respective case when the powder inside the same is ignited, result in at least one well-defined longitudinal splitting open per case with an open area of such a size that the powder is combusted more calmly and is thus

prevented from exploding. In particular as far as ammunition charged with LOVA powder is concerned, which thus in itself burns quite calmly when it is not pressurized, the gains in the form of reduced damage to the environment thus become considerable. The weakening according to the invention is in this connection not merely to be designed in such a manner that the split which is opened is sufficiently large to prevent further pressure increases in the powder, but the splitting is moreover to take place at such an early stage that the shells fitted in the respective cases preferably continue to remain in the respective case or at least are not imparted such a speed that they precisely by virtue of this increase the damage arising.

The longitudinal material weakenings which are characteristic of the method and the cartridge cases according to the invention can be produced in a number of different ways. The main characteristic of these material weakenings is that they are to be locally defined in such a manner that they function primarily as fracture indications so that, if the internal pressure rises above a predetermined value without the case being supported on the outside by the cartridge chamber of the weapon in question, the case will be split open more or less as if a longitudinal opening was being opened along a relatively large part of the length of the case. As will be easily understood, this produces a very rapid pressure reduction inside the burning powder which subsequently certainly will continue to burn, and with great intensity at that if it consists of nitrocellulose powder, but more like a stearin candle if it consists of LOVA powder.

As an example of different ways of producing the weakenings which are characteristic of the invention, mention can first and foremost be made of external or internal working, in which a part of the material thickness in the case is reduced locally or the material is in another way subjected to a locally delimited, well-defined weakening which produces the corresponding fracture indication. It has moreover emerged that it is

most often expedient to end the longitudinal weakenings with a transverse fracture indication which, e.g. with weakenings produced by mechanical working, can consist of a sharp edge transverse to the main direction of the longitudinal weakenings. Such a laterally directed fracture indication will in fact ensure that the cases are split open precisely in the form of the openings indicated above. Such laterally directed weakenings can also of course be produced in any other way which can be applied in order to produce the longitudinally directed main weakenings or by using a combination of a number of these methods. Other ways of producing these weakenings are thus soft-annealing which can be an excellent method on metal cartridge cases and which can be carried out with a delimited open flame, with a laser, with an electric arc or by means of induction coils. As far as cartridge cases made of metals with differing hardenability are concerned, it is also possible to conceive of locally varying the hardness of the material by isostatic working of the material in the cases so that the desired fracture indications are obtained. The abovementioned methods can moreover be combined with one another. As far as cartridge cases made of plastic and cartridge cases made of combustible material, but also metal cases, are concerned, the weakenings according to the invention can of course be incorporated into the cases directly during their manufacture by a variation of the material thickness in the case walls e.g. in the form of internal grooves with a small radius, a V-shape or other appearance. There are certainly also other methods of producing the weakenings which are characteristic of the invention but, since it is the weakenings per se which are important, the methods of producing these are of subordinate significance.

According to the invention, there is to be at least one of the weakenings, which are characteristic of the invention, per cartridge case but as a rule it will probably be expedient to provide each case with a number of such weakenings even though practical tests have shown

that as a rule it is only one weakening per case which is activated. Another question which does not have a general answer is how long these weakenings are to be in relation to the case length. As a rule, however, it will probably be expedient to make the weakenings extend along at least half the case length. Since different artillery pieces have cartridge cases of greatly varying thickness and shape, the length and the number of weakening stretches per cartridge case must nevertheless be determined by practical fire tests.

Both the method and the arrangement according to the invention have been defined in the following patent claims, but the invention is also to be described in somewhat greater detail in association with the attached figures, in which:

Fig. 1 shows a side projection of a cartridge case for an anti-aircraft automatic cannon designed in accordance with the invention while

Fig. 2 and Fig. 3 show a cross-section and longitudinal section on enlarged scale of the ends of the weakening bands which are characteristic of the invention while

Fig. 4 shows a cartridge designed in accordance with the invention including the case from Fig. 1 after it has been subjected to a fire test.

The cartridge case shown with the designation 1 in Figs 1-3 is provided with a number of weakening bands, of which 2, 3 and 4 are shown in the figure. In this instance, the weakening bands had been produced by, on the one hand, preliminary soft annealing and, on the other hand, subsequent mechanical working, a part of the material being worked off. As can be seen from Figs 2 and 3, approximately a third of the material thickness was worked off within the area where the working off was greatest and the working was ended with the previously mentioned sharp edge which is here designated as 5. As emerges mainly from Fig. 2, the weakenings are realized as plane workings which, as a result of the circular cross-section of the case, produce a material thickness

which is successively smaller and smaller towards the central line of the weakening.

In Fig. 4, the case 1 from Figs 1-3 is accordingly shown, here provided with a fitted shell 6 and after it has, together with its propellant charge of LOVA powder, been subjected to a fire test. In this connection, the propellant powder has been ignited and the increased internal powder gas pressure at 9 has split open the case along the weakening band 2. The sharp edges 5 ending each end of this band have in this connection functioned as fracture indications which have caused the splits also to go out towards the sides which has made the whole split come to comprise easily half the circumference of the opening. In this connection, split-open opening halves 7 and 8 have been formed, one on each side of the weakening band. As emerges from the figure, the shell 6 remained in its place in this instance, as is desired.

## Patent Claims

1. Method of, in fixed service ammunition, reducing the damage effect on the environment in the event of extreme pressure increases in the propellant charges of the ammunition such as in the event of accidental ignition and fire in the propellant powder included in the ammunition brought about by a shell hit or other damage to the ammunition store of which it forms a part, characterized in that each of the cartridge cases (1) or equivalent surrounding said propellant powder is provided with at least one preferably longitudinal material weakening (2-4) which is adapted in such a manner that, in the event of an internal pressure increase in the case (1) brought about by ignition of the propellant powder while the case (1) is without external support in the form of the cartridge chamber of a weapon or equivalent, it breaks along the weakening (2-4) and results in a splitting open (9) of the case material which is sufficiently large to prevent an explosion of the propellant powder and then to impart to the latter a calm or subsiding combustion.

2. Method according to Claim 1, characterized in that said weakenings (2-4) are adapted in such a manner that the cases are split open before the shells (6) fitted in the respective cases are forced out of the case neck by the internal powder gas pressure.

3. Method according to either of Claims 1 and 2, characterized in that said material weakenings (2-4) in the cases are produced by soft annealing carried out in a conventional manner such as by means of laser working, electric arc or by heating with an open flame or with an induction coil.

4. Method according to either of Claims 1 and 2, characterized in that said material weakening (2-4) in the cases (1) is produced by external or internal working with or without working off of material, the case material being made thinner within the area where the weakening is desired.



5. Method according to either of Claims 1 and 2, characterized in that said material weakening (2-4) in the cases (1) is produced as an external and/or internal isostatic working of the case material.

5 6. Method according to either of Claims 1 and 2, characterized in that said material weakening (2-4) is carried out as a combination of at least two of the methods defined in Claims 3 to 5.

7. Method according to one or more of Claims 1-6, characterized in that the respective longitudinal material weakenings (2-4) by one or more of the abovementioned methods are ended at their respective ends in such a manner that fracture indications (5) are formed there, which, on either side of the respective longitudinal weakening (2-4), extend essentially at right angles to the latter.

8. Cartridge case (1) for service ammunition designed to reduce, in accordance with the method according to one or more of Claims 1-7, the damage effect on the environment in the event of an extreme pressure increase in the propellant powder forming part of the charged ammunition, such as in the event of accidental ignition of the propellant powder caused by shelling or in another manner, characterized in that it has at least one longitudinal weakening (2-4) in the case material, this weakening being adapted in such a manner that the material, provided that the case (1) is supported by the cartridge chamber of the weapon provided therefor during the combustion of the powder, stands up to stresses from the internal gas pressure but breaks under the same gas pressure if the propellant powder is ignited when the case (1) is located outside said cartridge chamber and in this connection is split (9) open along the weakening (2-4).

9. Cartridge case according to Claim 8, characterized in that said weakening consists of one or more well delimited bands which are narrow in relation to the width of the case and extend along preferably more than half the length of the case.



10. Cartridge case according to Claim 8 or 9, characterized in that each weakening band is ended at its respective ends with a fracture indication in the form of e.g. a sharp edge which extends transverse to the longitudinal direction of the weakening band and thus ends the latter.
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